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THE DEVELOPMENT OF A BEGINNING READING SKILLS PROGRAM USING THE EDISON RESPONSIVE ENVIRONMENTS INSTRUMENT. FOURTH PROGRESS REPORT.

BY- GOTKIN, LASSAR G. MCSWEENEY, JOSEPH
NEW YORK UNIV., N.Y., SCH. OF EDUCATION

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A FOURTH PROGRESS REPORT ON THE DEVELOPMENT OF A BEGINNING READING SKILLS PROGRAM USING THE EDISON RESPONSIVE ENVIRONMENTS INSTRUMENT IS PRESENTED. THE ACQUISITION OF A SEQUENCE OF COMPLEX BEGINNING READING SKILLS IS EXAMINED. MOTIVATIONAL STRATEGIES ARE DISCUSSED. THE FOLLOWING HYPOTHESES WERE TESTED IN FIELD STUDIES--(1) THE EFFECTS OF TWO TYPES OF FEEDBACK ON THE ACQUISITION OF SOUND SYMBOL CORRESPONDENCE, AND (2) THE EFFECT OF MOTIVATION CONTEXTS ON ATTENTION IN YOUNGER LEARNERS. TABLES AND FIGURES ARE INCLUDED. (BK)

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Principal Investigators: Lassar G. Gotkin, Ed.D.
Joseph McSweeney, M.A.

Institute for Developmental Studies
School of Education
New York University

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I. INTRODUCTION

This, the Fourth Progress Report of our research in the development of a reading skills program making use of a complex teaching machine, covers the period from September 30, 1966 to September 30, 1967. The piece of equipment we use is the Edison Responsive Environments instrument.[1] That we use this instrument has led to some persisting confusions relating to the nature of our work. This instrument is engineered around the work of O.K. Moore and his responsive environments theory. Our work with the instrument does not involve an attempt to test Moore's theory or to replicate his work. Furthermore, we do not pretend that our goal is to teach children to read. Rather, we have been taking a painstaking look at the acquisition of a sequence of complex beginning reading skills. In the way we are doing this, we may well be carrying on the most completely controlled study of beginning reading yet conducted. In suggesting this possibility we do not claim that ours is the most relevant reading study or the most complete, but that it is one of the most detailed and clearly controlled in tracking the processes of acquisition. The sources for this claim are two-fold. First, by working with children from disadvantaged backgrounds and by careful pretesting, we know we are dealing with children who have little or no knowledge of the skills being taught. Second, by using completely individualized presentations in a controlled setting,

[1] Proper corporate identification: The "Talking Typewriter" of Responsive Environments Corporation.

we are in complete control of the instructional events. Furthermore, the children do not receive concurrent reading instruction in their classrooms. To date, the important limiting aspect of our research is the amount of time that individual children receive instruction. At this point we are talking about lesson sequences that at the most have gone 50 lessons in which the average instructional time is about 400 minutes, less than seven hours.

The above points should be kept in mind in reading the major topics about which this report is organized. For some of the topics general introductions have been provided to assist the reader in relating the detailed analysis of our work to the broader issues in the field.

A further point need be made. While we are certainly pleased with the report, this is not the best way to understand what our work is about. Such understanding can best be obtained by visiting our laboratory, observing children going through the lessons, and then discussing what you have observed. At no point in this report is the reader able to obtain the flavor of what actually happens as the children respond to the behavioral and motivational strategies.

II. MOTIVATIONAL STRATEGIES

A. INTRODUCTION

Our project is concerned with developing lesson sequences which will lead to defined objectives in predictable amounts of time. Those individuals who are unable to cope with the "vertical sequence" are provided with lessons from the "horizontal sequence" until they reach mastery.[2] Such direct instruction will fail unless the children attend to the lesson. In this section McSweeney and Richardson describe the body of techniques used to maintain the children's attention.

The significance of such motivational strategies rests in the observation that the schools have avoided direct reading instruction until the first grade. It has been argued that children were not ready for reading until they had reached the mental age of six years, six months. One aspect of the arguement was that the children have such short attention spans, a point made especially in regard children from disadvantaged backgrounds. One way to interpret what this section is about is that attention span is a dependent variable and motivational strategies the independent variable. That is, what techniques are available to the instructional programer to help him engineer the child's attention to direct reading instruction?

[2] For a description of the model of horizontal and vertical sequences see the Third Progress Report of this project.

The essential stimuli we have to deal with in beginning reading instructions are not among the most exciting images for young children. The information and excitement which can be drawn from letter symbols as a result of reading (decoding and interpretive skills) are beyond the competence and comprehension of prereaders. While the reinforcing effects of excitement, interest, information or just sheer exercise of ability accrue to readers as a result of applying learned decoding and interpretive skills to letter symbols, for the prereader there is little in the symbols themselves which can be reinforcing until the letters are decoded and meanings assigned. But the acquistion of decoding skills requires vocal responses to letter images. These dry symbols which betray little of their ultimate value to the young prereader must be mastered. In programing for the reader the problem is to make the use of reading skills reinforcing. In programing for the prereader the problem is to make the production responses (looking, listening, indicating and saying) reinforcing events. These production responses form the basis for shaping the decoding and meaning skills which open the way for the child to experience the later reinforcing effects of reading itself.

Before a letter can be decoded, it must be looked at. Before a child can produce a relevant sound response to a letter image, he must listen to the voice which is requesting this behavior. The behavioral requirement is to look at a letter or letters, listen to relevant information about the letters displayed and then to say something in conjunction with the images, usually the letter sound

involved. All of these attentional behaviors precede the actual decoding and interpretive behavior which is normally called reading.

This is the problem we faced early in our work: how to maintain attention to the audiovisual stimuli which were essential in producing the responses necessary for us to interpret the progress of both the child and our own techniques. The many social distractions in classroom teaching which compromise attention to lessons were eliminated by a special booth. But attentional problems persisted within this special environment. Each child works alone in an enclosed booth (4' x 4' x 8') unaware that he is being observed through one-way vision mirrors. The booth and the machine offer a variety of visual and tactile sensations. There are mirrors to be looked into, and an assortment of machine parts to touch. The controlling effects of a live teacher and group conformity are absent. The setting facilitates a sense of autonomy. A choice between fully attentive participation in the lesson and total playfulness represent the extreme of assorted options. The lesson being played by the machine represents only one, from among many, set of stimuli to which the child may devote his energy. The lesson must compete for the child's attention with such activities as looking in the mirrors, playing with the microphone, opening and closing the booth's door, and many more.

B. MOTIVATIONAL CONTEXTS

This section describes a group of techniques which have helped us maintain attention to the audiovisual stimuli. All of the S R chains described in Section III-B occur in motivationally treated contexts. Appendix A, Figure 1, defines a minimal context, in which

a plain letter is displayed, in contrast with a motivational context in which the letter occurs as part of a story or game sequence.

A minimal context is simply a display of a plain letter, and a request for some relevant behavior, such as "Say its sound." A more motivational treatment places the letter on the body of a fantasy animal, or shows a snake formed into a letter shape or uses letters to define a particular object, like the box in the game illustrated in Figure 1. The context can be broadened to include sequences of such images which form stories and games, appealing to the interests of young children. Each of our lessons has some such context, a story, game, or series of interesting illustrations, which carries the content behavior.

In some lessons the motivational context is directly related to the reading behavior. An example of a direct relationship between context and content in its most extreme form is the Mr. Charmer Lesson (Appendix A, Figure 2) In this lesson, the letter itself, transformed into a snake, becomes an interesting image to look at.

Each picture in Figures 2-6 represents colored slides which are displayed to the child one at a time. The machine voice played to the child during each slide is printed beneath each picture. The slides are numbered in the order in which they occur. Missing numbers indicate slides and voice not shown below. Dots indicate pauses in the machine voice to allow the child time to respond. Button presses are indicated in parentheses. (See Appendix A)

In addition to an interesting letter image to look at, there are other aspects of motivational treatment in this lesson. (Figure 2)

1) Animation

Slides numbered 5-7, 13-16, and 18-20, are seen in ¼ second intervals. These brief, exaggerated movements have consistently produced strong looking behavior. In other words, given a plain letter, attention to the projector screen can be increased by projecting the letter in some animated fashion as opposed to a still display.

2) Role Playing

The machine voice places the child in the simulated role of teacher as he tells the snake to come on out (Slide 2), tells him to make a letter (Slide 4), and corrects his error (Slide 17).

3) Operational Control

The child initiates some animated sequences by a button press (Slides 4 and 17). These particular presses are behaviorally relevant, that is, they are considered an essential part of the S-R requirements in shaping the oral sound response. Other presses (in other lessons) are not at all relevant from this skill view-point and are programed for motivational reasons. The thought here is that a button press keeps the child's hand actively involved in the lesson, and on occasion, such as the Mr. Charmer sequences, can assume role-playing characteristics, if the child senses that he has operational control of subsequent events by means of the button press.

Trying to meaningfully relate a motivational context to some skill content such as the snake lesson above can be an exercise in mental gymnastics. The other extreme, where

content and context have little to do with each other, is a far richer source of motivational ideas. The problem we faced was, would such a strategy work? The lump story (Fig. 3) is an example of a whole range of lessons where the skill content (letter image) and the motivational context (story) occur as separate events. The letters the child looks at and the oral sound responses he makes are only temporally related to the story. A skill event (oral sound response to letter image) is followed by a story event, etc. in the fashion of television programing where commercial and program follow each other as separate events, related only by time and other physical projection factors. (See Appendix A, Figure 3)

In terms of workability, lessons such as the lump story secure looking, listening and response-production behavior just as well as the snake lesson where the skill content and motivational context are simultaneous, as opposed to separate events. When the plain letter image is displayed, after a brief story sequence, the children do not turn away from the projector screen and engage in irrelevant activity unrelated to the lesson, but continue to look, listen and respond as attentively as during the story portion.

The snake lesson and the lump story define end-points of a continuum on which the manner of relating skill content to motivational context may be compared. Between these extremes is a third category of lessons in which letter images and their sounds are used as labels and names for animals, characters and objects. The ordinarily meaningless sounds and images are

simply given a dimension of meaningfulness by defining them to the children as the names for animals, characters or objects. In the zoo story, the letter images become the names of fantasy animals. (See Appendix A, Figure 4). In the hide and seek game, the letter images become the names of fantasy characters. The sound balloon is the basis for playing the game "who is hiding." (See Appendix A, Figure 5). In the hide and seek lesson, the child assumes the role of game participant, while in the zoo story, the child is simply an intrepreter of events, a standard role played in most of the lessons. In the box game the letter images are used as labels for boxes. Again, the response role is one of game-participant. (See Appendix A, Figure 6).

The use of letters and their sounds as labels for characters and objects enables us to extend the scope of prereading instruction from decoding skills (deciphering images in terms of sounds) to include interpretive skills (answering meaningful questions). The question, "What sound does this letter make?", or the statement, "Say the sound of this letter" involves decoding skills only. The response requirement is simply to produce the associative sound. In contrast to this, questions referring to letter images placed on characters or objects such as "Which animal is that?" or "Which box is the ball under?" requires the child to decode the symbol in terms of its sound and reproduce it as the answer to a question which has concrete meaning for the young prereader. This brings the ordinarily abstract and meaningless symbols into a more comprehensible

reference system. Both decoding and interpretive responses are essential aspects of reading behavior. Phonic instruction, at the beginning level, normally does not include interpretive skills. The motivational techniques described above make it possible to include interpretive responses as part of phonic instruction.

III. BEHAVIORAL STRATEGIES AND FIELD TEST RESULTS

A. INTRODUCTION

The previous section was concerned with techniques developed to maintain children's attention to lessons involving direct instruction in beginning reading skills. This section presents the skills taught and how well they were learned.

There is a considerable difference between keeping someone involved in a lesson and actually teaching. Television cartoons keep children attending for long periods of time, yet the amount and type of learning accruing to the viewer need be questioned. Unfortunately, many educational activities are evaluated more on their basis to entertain than on their promotion of effective learning.

In this section the reading skills are presented in detail and a programing paradigm related to teaching these skills is described in detail. Emphasized in this description are the findings of three successive field tests which detail the way this paradigm evolved from problems the children had in reaching mastery.

What is most important is the level of mastery being achieved. Examination of the data reveals test performances coming closer and closer to 100% for most of the children. The significance of these results depends on recognizing that we are talking about direct reading instruction for five year old ghetto children, children who characteristically are labeled not yet ready for direct instruction in reading skills, especially skills involving phonic synthesis and analysis.

B. DESCRIPTION OF BEHAVIORAL OBJECTIVES

The objectives of the program are to teach phonetic analysis and synthesis of letter combinations, more popularly labeled, "sounding out" skills. The important specifications of these objectives are:

1. Indicating Response: Point to a letter (or press a letter button) in response to its sound. Example: A pre-recorded machine voice says, "Point to m." Child scans several letter buttons and points to the button with m on it.

2. Oral Sound Response: Say a letter sound in response to its image. Example: Machine displays the letter m on screen. Machine voice says, "What's the sound of this letter?" Child looks at letter and says "mm."

The indicating skill may be thought of as a type of spelling behavior, where sounds are first heard and their corresponding images are selected or constructed. In contrast, the oral response is a type of reading behavior, where images are first looked at and their corresponding sounds are vocalized.

3. Unitary Response to Letter Combinations: After learning the individual sounds for m and o, the child then sees these two letters together in the form mo, and is told that the two letters make the sound "mo" (as in "mom").

He then practices the sound "mo" in the presence of the figure mo. In effect, the child behaves as if the combination mo was simply a new configuration with its own distinctive sound. This unitary oral response is an association of sound with symbol and forms the basis for higher-order blending skills in our program.

4. Blended Response to Letter Combinations: A blended response to two letters such as mo is different from the unitary response described above. A blended response requires an ordered synthesis of two or more letters (or combinations). The oral blend involves a left-to-right movement of the eyes in conjunction with a left-to-right vocalization of the sounds associated with the letters in the configuration. For the configuration mo, this means vocalizing the m sound first, the o sound second and mixing the sounds together to produce the blended sound "mo" (as in mom). Note that the unitary response described in #3 above requires no such ordered synthesis.

Pre and Posttest data are reported for three sequence revisions in Table 1 (A,B,C,D). These data are for the indicating and oral sound responses to single letters. Table 2 presents data for the unitary response to some two and three letter combinations. Data for the blended response will be reported at a later date.

TABLE 1. SINGLE SOUNDS

A. SR (Initial Sequence)

Student Number	Pretest		Posttest	
	indicate	oral	indicate	oral
1	33.3%	0.0%	100.0%	50.0%
2	0.0	0.0	100.0	100.0
3	0.0	0.0	100.0	100.0
4	0.0	0.0	100.0	66.6
5	0.0	0.0	66.6	0.0
6	0.0	0.0	83.3	66.6
7	0.0	0.0	100.0	66.6
$\bar{X}$	4.8	0.0	92.8	64.3

B. SR I (First Revision)

8	33.3%	0.0%	100.0%	100.0%
9	0.0	0.0	33.3	33.3
10	33.3	0.0	0.0	0.0
11	33.3	0.0	100.0	66.6
12	0.0	0.0	100.0	100.0
13	0.0	0.0	100.0	83.0
14	33.3	0.0	33.3	66.6
15	100.0	0.0	100.0	66.6
16	0.0	0.0	33.3	0.0
17	0.0	0.0	100.0	66.6
$\bar{X}$	23.3	0.0	70.0	58.3

C. SR II (Second Revision)

18	0.0	0.0	66.6	100.0
19	0.0	0.0	100.0	100.0
20	33.3	0.0	100.0	100.0
21	0.0	0.0	100.0	100.0
$\bar{X}$	8.4	0.0	91.7	100.0

D. SR III (Third Revision)

22	50.0	0.0	100.0	100.0
23	0.0	0.0	75.0	75.0
24	25.0	0.0	100.0	75.0
25	25.0	0.0	75.0	75.0
26	25.0	50.0	25.0	50.0
27	25.0	0.0	100.0	100.0
28	25.0	0.0	100.0	100.0
29	50.0	25.0	100.0	100.0
$\bar{X}$	28.1	9.4	84.4	84.4

TABLE 2. UNITARY RESPONSE

TO TWO AND THREE LETTER COMBINATIONS

SR I (First Revision)

Student Number	Pretest indicate	Pretest oral	Posttest indicate	Posttest oral
8	- *	- *	80.0%	75.0%
12	-	-	100.0	75.0
15	-	-	80.0	43.7
17	-	-	100.0	62.5
X	-	-	90.0	64.1

SR II (Second Revision)

18	- *	- *	60.0%	83.3%
19	-	-	83.3	- *
20	-	-	100.0	81.8
21	-	-	100.0	50.0
X	-	-	85.8	71.7

SR III (Third Revision)

24	- *	- *	100.0%	100.0%
25	-	-	66.6	40.0
27	-	-	100.0	100.0
28	-	-	66.0	40.0
29	-	-	100.0	100.0
X	-	-	86.5	76.0

* none given

C. THE SR SERIES

In the SR series (Table 1,A) most of the lessons required the child to point to a letter in response to its sound. A few terminal lessons toward the end of this series required the oral response. Only two children (No. 2 & 3, Table 1, A) demonstrated criterion level performance of the oral response as a result of training mainly on the indicating response. The lower level of posttest achievement for the oral response was due to the lack of opportunity to produce this response in the lessons. The success of the indicating response, on the other hand, was due not simply to a greater opportunity to exercise this skill, but to the controlling effects of relevant feedback. The stimulus-response (S-R) structure for the indicating response involved the use of a mnemonic associated with each letter. The child first learned to associate the visual letter o with the word round and the visual letter m with the word mask. After these associations were formed, it was possible to direct the child's finger to the correct button using the mnemonic association as feedback. The following sample from actual lessons shows the use of the mnemonic as corrective feedback. What the machine is pre-recorded to say is written between quotation marks. The behavior of the child is described between parentheses.

Sample Stimulus Number	Sample Auditory and Visual Stimulus Played by Machine
2.1	"Point to the letter that makes the sound mm"...
	(Child points to one of three letter-buttons.)
2.2	"mm is the letter that looks like a mask."
	(Child confirms or revises selection based upon his comparison of the word mask with his letter-choice.)
2.3	"Now press the mm button."
	(Child presses button with letter m on it.)

In stimulus number 2.1 and 2.2 the child's indicating response is being controlled by the mnemonic. After hearing "point...." in stimulus 2.1, the child selects the letter image which he thinks corresponds to the sound being played by the machine. A second later (after pointing) he hears the mnemonic phrase ("It's the mask letter" or "the round letter"). At this point he revises or confirms his response. Stimulus number 2.3 is certain to elicit a more accurate response, because it asks the child to press the same letter-button which he has just pointed to. Since corrective feedback was given for the preceding pointing response, the following pressing response is usually more accurate because its content (letter image) is the same. This routine is repeated for the other single letters. The response to stimulus number 2.3 is usually correct. However, feedback is still available in the form of a locked-key. If the child does press the wrong letter-button, it won't depress.

The locked-key tells him to revise his choice. This is not shown in the sample, because correctness on 2.3 is almost 100 percent for most children.

The following table is a summary, in paradigm form, of the SR series. Each paradigm represents several lessons and reveals their underlying behavioral structure. Paradigm 1 represents the beginning portion of the series, Paradigm 2, the middle and last portion of the series.

Level Number and Name	Instructional Paradigms				
1 Echo Chain	$S^{1.1}$ -m- This is mm, say mm	$\longrightarrow$	$R^{1.1}$ child says mm	$S^{1.2}$ next letter	
2 Indicating Chain	$S^{2.1}$ point to mm	$\longrightarrow R^{2.1}$ child points to a letter	$S^{2.2}$ mm is the mask letter	$\longrightarrow R^{2.2}$ child confirms or revises choice	$S^{2.3} \longrightarrow R^{2.3}$ press mm — depress m key

The symbol S in these paradigms denotes what the machine shows and says to the child. In $S^{1.1}$ the machine is showing the letter m on the screen (-m-) and saying "this is mm, say mm." Each R above describes what most of our subjects usually do in response to S.

Paradigm Number 1 illustrates a simple echo response. Most children, when told what to say, will repeat the model as precisely as they can. This is the manner in which the mnemonic

associations were learned, i.e., by means of simple echoes and visual matching responses. The bulk of the SR series is illustrated by Paradigm 2.

This paradigm consists of a chain of three S- R units. The first unit ($S \xrightarrow{2.1} R^{2.1}$) elicits a pointing response from the child. The second unit ($S \xrightarrow{2.2} R^{2.2}$) gives the child information and opportunity to correct his pointing response. The last unit ($S \xrightarrow{2.3} R^{2.3}$) elicits a pressing response. Note that the content of both the pointing and pressing units is the same (letter m).

A more detailed analysis of the indicating response skill is currently being prepared for publication. This paper will include a more complete description of the developmental research leading to the response chain presented here as well as a discussion of the relevance of this work for a more generalized approach to sound-symbol learning.

The SR series described above told us essentially that the indicating response coupled with simple echoes could not entirely support the oral sound response without more direct opportunities to produce successful oral responses to letter images. Although the child was required to echo the letter sounds in the presence of their images, this did not transfer to criterion performance which requires production of the letter sound in answer to a question or a command, i.e., "What sound does this letter make?" or "Say the sound of this letter."

1. The SR I Series

The number of lessons based upon the oral sound response was increased. Because of its success in the SR series, the use of the mnemonic device was also increased. The child not only continued to indicate a letter by means of its mnemonic, but also orally produced the mnemonic in response to its letter image. This is illustrated in the following sample:

Sample Auditory and Visual Stimuli Played by Machine
-slide showing letter m- "This is the mask letter, say mask letter"..... (child echoes mask letter)
-slide showing letter m- "Is this the mask letter or the round letter?".... (child says mask letter)... "It's the mask letter."

The oral sound lessons in this series were based mainly upon various types of echoes and multiple choice responses. These oral sound lessons followed the indicating lessons which contained the newly added oral mnemonic response. The oral sound lessons are illustrated in the following sample:

Sample Audiovisual Stimuli
-slide showing letter o- "The sound this letter makes is oh, you say oh".....
-slide showing letter o- "Does this letter make the sound oh or mm?..... It's oh."

The results of this series are shown in Table 1B. Again, mastery at the indicating level was generally higher than at the oral level, despite the added lessons based upon the vocal production of sounds to letter images. One of the contributing causes to the low level of acquisition was the use of the oral mnemonic. As the children moved from the indicating lessons where they learned to point to letters correctly, they were then required to say the mnemonic in response to the letter image. It was hoped that this requirement would somehow strengthen the oral connection between letter sound and its image. After this training, the children entered lessons which asked only for the letter sound such as mm or oh. What in fact happened, was this: the question, "What sound does this letter make?" produced the response "It's the mask letter" or "the round letter." In other words, the trained oral association of mnemonic with letter image was interfering with the production of the letter sound. In addition to the interference of the mnemonic with oral response production, this new procedure appeared to interfere with the indicating response. As the child was being ineffectively taught to produce the mnemonic as an oral response to the visual letter the mnemonic began to lose effectiveness as corrective feedback for the indicating response.

The programing dilemma we faced was precisely how to use a successful indicating behavior (pointing or pressing) achieved in the SR sequence in order to support or facilitate the

acquisition of a related oral response (saying the letter sound in response to its image). The problem was intensified by the fact that the indicating response could be controlled with a high degree of success.

We could practically guarantee almost 100% accuracy in getting the child's finger to the correct button, but were far less effective in producing the next essential behavior - a correct oral sound response to a letter image.

2. The SR II Series

In the SR II series, the oral mnemonic was dropped from the response requirements but continued as auditory feedback for the pointing response. The child never answered the question, "Is this the mask letter or the round letter?" but heard the mnemonic as feedback in the stimulus "point to m... it's the mask letter." After correctly pressing the letter button, the same letter was immediately displayed on the screen and the question was asked, "What sound does this letter make?" Accuracy of responding to this latter question was 100%. In this direct manner, the problem of how to use the indicating response to support a successful oral sound response to the letter image was solved. First, the child's pointing response was controlled by the auditory mnemonic. The next stimulus was a request to press the same letter. At this point, pressing accuracy was almost 100% due to the corrective effect of the mnemonic feedback. The last stimulus in this chain was a projection of the letter image which was just pressed and a

request to the child to say its sound. No errors in the oral sound response were observed as a result of this technique. The solution of how to use the pointing response to support the oral response was simply to arrange them in successive, temporal order. The following sample shows this chain of events as it appears to the child in an actual lesson.

Sample Stimulus No.	Sample Audiovisual Stimuli
2.1	"Point to mm." (child points to one of several buttons)
2.2	"mm is the mask letter." (child revises or confirms his pointing response)
2.3	"Now press mm." (child presses m button)
3	(Machine displays letter m on screen) "Say the sound of this letter." (child says mm ... "it's mm.")

Stimuli numbers 2.1, 2.2, and 2.3 require indicating responses (pointing and pressing). The last unit, 3, is an oral sound response to the same letter. Accuracy of responding on 3 is based upon corrective feedback in the preceding stimuli. An accurate oral response is elicited on the basis of a preceding indicating response which has been either confirmed or corrected by feedback. Note that in stimulus 3, feedback is still provided by the last phrase..."it's mm." In paradigm form, the technique looks like this:

$S^{2.1} \rightarrow R^{2.1}$ point to mm — child points

$S^{2.2} \rightarrow R^{2.2}$ mm is the mask letter — child confirms or revises pointing response

$S^{2.3} \rightarrow R^{2.3}$ press mm — child presses m button

$S^{3} \rightarrow R^{3}$ -m- say the sound of this letter — child says mm

The first two units are dropped (2.1, 2.2) as the indicating response comes under control of the letter sound. The last two units (2.3, 3) are used to begin training an abstract oral response to the letter image. Since criterion performance requires an oral response without preceding indicating support, a new chain based entriely upon oral responding was devised. This chain begins with a low-level, oral response in the form of a simple two-choice question.

$S^{4.1}$	$R^{4.1}$	$S^{4.2}$	$R^{4.2}$	$S^{4.3}$	$R^{4.3}$
-m- Is this mm or o?	Child selects and reproduces one of the sounds	It's mm	Child listens to feedback	-m- Say the sound	It's mm

The low-level, multiple choice stimulus (4.1) requires a simple selection and reproduction of one sound. Correctness of responding to this simple two-choice question ($R^{4.1}$) is influenced by previous training on the indicating chain. The second unit ($S^{4.2} \rightarrow R^{4.2}$) presents feedback to the child consisting of the sound he should have said in $R^{4.1}$. The listening response to this feedback in the second unit ($R^{4.2}$) is unobservable, but has been inferred from the children's use of the feedback in the last unit. Those children who responded incorrectly to the first two-choice question ($S^{4.1}$) have been observed to respond correctly to the last question ($S^{4.3}$) in almost every case. The existence of a listening response ($R^{4.2}$),

in which the children attend to feedback, has been inferred from this behavior.

How this chain appears to the child in an actual lesson is shown in the following sample:

Sample Number	Sample Audiovisual Stimuli
4.1	(Machine displays letter m on screen) "Is this the letter mm or oh?"... (child selects and reproduces one of the sounds)...
4.2	"It's mm" (child listens to feedback)
4.3	(-m- displayed on screen) "Say the sound of this letter"... (child says mm)..."It's mm.

Toward the latter part of the SR II series, the simple two-choice question is dropped ($S^{4.1} \longrightarrow R^{4.1}$) and the criterion level response is required. The structure of the chain now looks like this:

$S^{5.1} \longrightarrow$ -m- say the sound

$R^{5.1}$ child produces or does not produce a sound

$S^{5.2} \longrightarrow$ it's mm

$R^{5.2}$ child listens to feedback

$S^{5.3} \longrightarrow$ -m- say the sound

$R^{5.3}$ child says it's mm

Correctness of responding on the first unit ($S^{5.1} \longrightarrow R^{5.1}$) is influenced by training on the previous, oral-selection chain (Fig. 7). Children who responded incorrectly to the first question ($S^{5.1}$) have been observed to respond correctly to the last question in this chain ($S^{5.3}$). For this reason, the existence of a listening response ($R^{5.2}$), although not directly observable, has been inferred.

The entire SR II series is represented in the following table as a series of chains, in paradigm form.

Fig. 7

Level Number & Name	INSTRUCTIONAL PARADIGM							
1 ECHO	$S^{1.1}$ -m- this is mm, say mm	→ $R^{1.1}$ child says mm	$S^{1.2}$ next letter or combination					
2 INDICATING CHAIN	$S^{2.1}$ point to mm	→ $R^{2.1}$ child points to a letter	$S^{2.2}$ mm is the mask letter	→ $R^{2.2}$ child confirms or revises choice	$S^{2.3}$ press mm	→ $R^{2.3}$ child presses m button	$S^{2.4}$ next letter or combination	
3 INDICATING/ ORAL CHAIN	$S^{3.1}$ press mm	→ $R^{3.1}$ child presses m button	$S^{3.2}$ -m- say the sound	→ $R^{3.2}$ child says mm	$S^{3.3}$ next letter or combination			
4 ORAL SELECTION CHAIN	$S^{4.1}$ -m- is this mm or o?	→ $R^{4.1}$ child produces one of the sounds	$S^{4.2}$ it's mm	→ $R^{4.2}$ child listens to feedback	$S^{4.3}$ -m- say the sound	→ $R^{4.3}$ it's mm	$S^{4.4}$ next letter or combination	
5 ORAL CONSTRUCTION CHAIN	$S^{5.1}$ -m- say the sound	→ $R^{5.1}$ child produces or doesn't produce a sound	$S^{5.2}$ it's mm	→ $R^{5.2}$ child listens to feedback	$S^{5.3}$ -m- say the sound	→ $R^{5.3}$ child says it's mm	$S^{5.4}$ next letter or combination	
6 CRITERION	$S^{6.1}$ -m- say the sound	→ $R^{6.1}$ it's mm	$S^{6.2}$ next letter or combination					

The SR II series is a complex system of structurally different S—R chains. It is quite possible that this network can be reduced to two components. An exploratory study recently revealed that a simple combination of echoes and oral construction chains (levels 1 and 5) could effectively teach the oral sound response to single letters. Four out of five children demonstrated criterion level performance (level 6) in only three, 5-minute sessions. The indicating response was not used in this study to support the oral response. One child did not attain criterion performance, due, we suspect, to the lack of motivating stimuli in these trials. The problem of interesting stimuli for young children is reported in the previous section of this paper.

The behavioral structure of our most effective series to date can be generalized to the following form, which represents both the indicating and oral chains in levels 2 through 5. The content of the entire chain is the same.

$S^1 \longrightarrow$	R^1	$S^2 \longrightarrow$	R^2	$S^3 \longrightarrow$	R^3
do x	responds or doesn't respond	x is done this way	listens to how x is done	do x	does x

The correctness of the first active response ($S^1 \longrightarrow R^1$) is doubtful, that is, this is the first time the subject is faced with performing in a new, less certain manner. However, the correctness of the second active response ($S^3 \longrightarrow R^3$) is more certain. The subject's attention to the feedback consisting of

what he should have done ($S^2 \longrightarrow R^2$) increases the probability of correctness on the second active response ($S^3 \longrightarrow R^3$). As the same content is repeated in this chain, the correctness of R^1 increases.

It does appear that one important requirement in guaranteeing correct responding is to design an instructional sequence such that a doubtful response of low probability is followed by a more certain response of higher probability. The role of feedback ($S^2 \longrightarrow R^2$) is to make the correctness of the response which follows (R^3) more probable. In the same manner, the role of R^3 is to make a repetition of R^1 more probably correct. The data to substantiate this point is the subject of further reports. The important point here is that the successful SR II and SR III series is based upon such a system and the above interpretation is relevant to this empirically validated system.

D. PRE AND POSTTEST RESULTS

The pre and posttest data for the single letters are presented in Table 1. The initial sequence and the three successive revisions are represented in sections A, B, C, and D of this table. The averaged results at the bottom of each section show clear pre - posttest gains in all cases, however, there are certain fluctuations in the posttest average which require further explanation.

The indicating average for the initial sequence (SR) is

high, 92.8%. There is a noticeable drop in this average in SR I to 70%. This decrement was attributed to the loss of effectiveness of the mnemonic to support the indicating response when the mnemonic was used in the oral response dimension. This problem was discussed in the previous section. In support of this conclusion the indicating average is again high, 91.7, in the SR II results where the mnemonic has been removed from the oral response dimension. The SR III results were obtained from Head Start children. Due to the short duration of this program and the irregular attendence of the children, the group was moved as quickly as possible through the sequence. The result of this procedure is reflected by the slight drop in the indicating average to 84.4 produced principally by the failure of a single S, #26, to acquire the indicating skill.

The averaged posttest results for SR in the oral response show definite gains; however, the results are far from a desired 100% criterion. In SR I the oral response average was not improved due to the failure of using the mnemonic as support for the oral response. However, the 100% results on SR II reflect the success of the use of the indicating response to support the oral response. The drop in the averaged results shown by the 84.4% in SR III was attributed to the previously mentioned problems with the use of Head Start children.

Table 2 shows the pre and posttest results for the unitary response. The indicating response average for blended pairs in SR I is higher than the average for the single letters (see

Table 1,B). This probably reflects the fact that mnemonic was not used with blended pairs freeing the indicating response at this level from the burden of the use of the mnemonic in the oral response dimension. The high indicating response scores for all revisions reflect the use of the same techniques found effective for single letter acquisition.

For the oral response to letter combinations the averaged results show the increasing effectiveness of the successive revisions. It should be noted however that the SR III results, obtained from the Head Start Ss, may not reflect the full power of this section of the revision.

E. CONCLUSION

New data is presently being gathered on a revised series. This series will report upon the effectiveness of higher-order blending skills which involve "sounding out" two and three letter combinations to produce meaningful words. The series reported here involves only the unitary, oral response to single, double and three letter combinations.

The behavioral and motivational techniques developed for the unitary oral sound response are applicable over a wide range of content. The skill of associating names or sound with symbols is obvious in such diverse areas as colors, numerals, body-parts, musical notes, and a wide variety of objects.

IV. BASIC RESEARCH

A. INTRODUCTION

Ours is essentially an applied research project. In the process of developing and testing lesson sequences important issues related to basic research arise. Two such basic research issues were deemed important enough to design and conduct pilot studies.

The first explores the question of feedback, "What kinds of feedback are effective?" While the answers to this question are of great importance generally in the design of equipment, it has specific relevance in our work. The basic feedback mechanism in the ERE instrument is the locked keyboard. Simply, the locked keyboard operates so that only the one key will depress; the remainder of the keys are locked. If the learner presses a key which does not represent the correct response, it will not depress. In terms of Moore's theory this type of feedback is deemed to be sufficient. In our work we have found this to limit learning as well as our programing techniques. Richardson's study compares the feedback of the locked keyboard with positive feedback.

Earlier in this report it was pointed out that educators often speak of attention span as a characteristic of the individual. Without denying this, it is still possible to treat attention as a variable dependent upon aspects of instruction. Motivational strategies have been discussed earlier in this report. In the second study, McSweeney has documented the effects of motivational contexts on attentional behavior. His study demonstrates the effectiveness of such techniques on re-

ducing irrelevant behavior.

B. EFFECTS OF TWO TYPES OF FEEDBACK ON THE ACQUISITION OF SOUND-SYMBOL CORRESPONDENCE: The Problem of the Locked Keyboard as a Feedback Mechanism

1. Introduction

In several of our progress reports as well as other places we have discussed the problem of the locked-key mechanism as a limiting feature of the ERE. The problem, as we have presented it, is simply that the exclusive use of the locked-key as feedback for a sound-symbol indicating response produces inattention, random pressing behavior, and a resultant failure to acquire the sound-symbol indicating skill. We have found it necessary to "program around" this problem by training a pointing response which may be followed by positive corrective feedback in the form of a visual image or the structural mnemonic. This problem and its solution were mainly the result of careful observation rather than controlled experimental analysis.

A pilot study was designed to experimentally compare the behavior produced by locked-key feedback with that produced by positive verbal feedback. Negative locked-key feedback is the stimulus of the locked-key following an incorrect pressing response which tells the child, "Not that one." Positive verbal feedback is a verbal stimulus following an incorrect pointing response which has previously been demonstrated to control that response. It was hoped that, in addition to verifying our hypothesis regarding the superiority of positive feedback, the study would provide further insight into the acquisition of the sound-symbol skill and the role of positive corrective feedback.

2. Subjects and Procedure

Three symbols were printed on the three keys exposed to the child, a circle, a square, and a star. The sounds associated with each symbol were chosen for dissimilarity. The circle was associated with a squeaking sound, the square with the sound of a jingling bell and the star with a single note on a xylophone.

Two groups of 5 children were selected from the Head Start program at P.S. 175, however, two of the children from Group I failed to complete the experiment due to absences. The experiment was conducted in four sessions (See Table 3) consisting of a machine skills session, two sound-symbol training sessions and a final criterion session. Both groups received the same machine skill training on Day 1. On Day 2 and Day 3, Group I received sound-symbol training with only the locked-key as feedback for an incorrect response associated with that sound. Only the correct key operates so if the child makes an error he finds the key locked and the machine waits for the child to depress the correct key before initiating the next trial.

Group II also received sound-symbol training on Day 2 and Day 3 but verbal feedback was provided for an incorrect indicating response. According to this procedure the S hears the sound and points to the key. If he is pointing to the correct key he is immediately allowed to press it. If the S points to an incorrect key he hears the verbal cue ("circle," "square," or "star") associated with the symbol and he is allowed to press the key only after correcting his pointing response.

TABLE 3

Outline of Experiment

	GROUP I	GROUP II
Day 1	Machine skill training	Machine skill training
Day 2	Sound-symbol training (locked-key feedback)	Sound-symbol training (verbal feedback)
Day 3	Sound-symbol training (locked-key feedback)	Sound-symbol training (verbal feedback)
Day 4	Criterion (locked-key feedback)	Criterion (locked-key feedback)

Day 4, the criterion session consisting of 60 trials, was identical for both groups. The procedure for Day 4 was the same as the procedure described for Day 2 and Day 3 for Group I using the locked-key as feedback for an incorrect response. All sessions were observed and all pointing and pressing responses were recorded by the observer.

3. Results

The results for the 60 trials of the final criterion session are shown in Table 4. The data are the number of trials on which the S's first key selection was correct. The mean and variance were computed for each group. An F ratio was computed to check the assumption of homogenity of variance and was found to be not significant at the .05 level. So a t-test for the difference between two means of independent samples was performed with a pooled variance. The t value of 2.74 was found to be significant at better than the .025 level.

In addition to the difference in criterion performance between the two groups a few other points should be noted. S #3 of Group I got 14 out of 60 correct which is below the chance level of 20 correct but the other two Ss in this group performed better than chance, indicating that some measure of learning had occurred. Group II appears to be divided into two distinct clusters. S #3 shows a perfect score of 60 while S #4 missed only three out of 60. In contrast to this, the other three Ss of Group II have scores ranging from 40 to 48. These scores, although higher than Group I scores, are less than perfect.

TABLE 4

Number of trials in which the first choice was correct out of 60.

GROUP I		GROUP II	
S#	#Correct	S#	# Correct
1	37	1	43
2	32	2	48
3	14	3	60
		4	51
		5	40
Mean	27.7	Mean	49.2
S^2	146.33	S^2	75.3

$F = 1.94$; ns $p > .05$

$t = 2.74$; s $p < .025$

4. Discussion and Conclusions

The data clearly indicate that performance following positive corrective feedback is superior to that following negative feedback at least for the case involving sound-symbol correspondence for small amounts of material. The results do not show, however, that learning does not occur following negative feedback as evidenced by the apparently better-than-chance performance of two of the Group I Ss. This leads to the question of just what has been learned or what is interfering with performance. The answers may be related to the less-than-perfect performance of the three Group II Ss. Fruitful places to look for answers to these questions might be error distributions, latency distributions and retention measures. So, one of the most important aspects of this study are its implications for research leading to a deeper analysis of the sound-symbol skill.

Another important aspect of this study, however, is that it arose from developmental programing research. We discovered a problem with the negative locked-key feedback of the ERE machine and developed a solution through experimental programing techniques. We have now been able to expand our understanding of this solution through formal research. The results of this study, and others like it, may be used to supplement our developmental research by indicating more efficient and effective ways of applying our developmental discoveries.

C. THE EFFECT OF MOTIVATION CONTEXTS ON ATTENTION IN YOUNGER LEARNERS

This pilot study explored the effects of motivational contexts on learner attention in a machine instructional setting. An extended discussion of the range of motivational contexts used in the lessons is contained in an earlier section.

Eight sessions (1-8) requiring visual matching of three plain letter shapes by means of pointing comprised a minimal context (Table 6). Eight additional sessions (9-16) required the same task of visually matching identical letter shapes but involved a greater variety of stimulus and response modes. Sessions 9-16 comprised the motivational context (Table 6). The total time that each of five students engaged in irrelevant behavior for different treatments was compared using an F test and a 2-way analysis of variance. A longer mean duration of irrelevant behavior was recorded for minimally treated sessions. The difference between treatments was significant at the .05 level and barely significant at the .025 level.

Subjects were kindergarten children in Harlem, P.S. 175. Pre-test knowledge of the task (visual matching) was 100% for each S. Each session was five minutes (machine time), one session per day, given on successive days. All the lessons were administered by the ERE machine. Child was alone in a 4' x 4' x 8' room. Irrelevant behavior constituted looking in mirrors, looking around booth away from machine, handling door or door knob, located behind child, getting out of chair, handling machine parts, unrelated

to lesson (microphone, panels, lucite housing). Duration of irrelevant activity was cumulatively recorded by means of stop-watch, E observing outside room through one-way mirrors.

In the first eight sessions, the child was presented a plain letter shape on the projector screen and was asked to point to the same letter on his keyboard. An example of this form is shown in Table 6, minimal context. The machine advanced to the next letter immediately after the child responded. In sessions 9-16, the same letters and matching task were placed in varying contexts designed to engage the child's interest. Instead of pointing to a letter, the child picked up a rubber stamp and stamped the matching letter, or picked up a felt pen and colored it. In addition to motivational treatment of the response mode, such as stamping, coloring or pressing buttons, the letter the child looked at on the projector screen was also motivationally treated. Occasionally the child saw the letter-to-be-matched as a picture of a snake formed into the letter shape. Examples of other treatments are shown in Appendix A, Fig. 1.

The basic data, duration of irrelevant behavior for each session, is summarized in Table 5. For sessions 1-8, the mean duration for each student is quite variable, reflecting individual predispositions to listen and perform attentively or engage in irrelevant behavior. Students number 1 and 4 exhibited the least amount of inattention to the task, while the remaining

students engaged in a substantial amount of irrelevant behavior (I.B.).

The duration of I.B. increases for all students as the sessions are repeated. Student no. 4 did not begin to become inattentive until session 4, and by session eight, his I.B. had increased to 40 seconds. This is a typical effect. Children are normally most attentive and display the least amount of I.B. during the first three sessions. The novelty of the machine setting seems to account for this effect. Thereafter, I.B. begins to rise for all children observed.

The effect of sessions 9-16 is evident over all students. I.B. decreased rapidly during session nine, below each mean for the previous sessions, and continues a general decline for all students as the motivational sessions continue.

The purpose of the exploratory study was to verify the fact that the motivational techniques used in these sessions could significantly reduce irrelevant behavior for all subjects resulting in increased attention to the audiovisual stimulus. A known task (matching letters) was purposely chosen to control any influence which a more unfamiliar task may have upon attention.

TABLE 5. DURATION, IN SECONDS, IRRELEVANT BEHAVIOR FOR EACH OF SIXTEEN SESSIONS

Student Number	Minimal Context Visual Matching Session Number									Motivational Context Visual Matching Session Number								
	1	2	3	4	5	6	7	8	$\bar{X}$	9	10	11	12	13	14	15	16	$\bar{X}$
1	7	14	23	30	20	28	31	35	24	5	0	0	6	0	0	0	0	1
2	64	52	91	105	50	105	80	85	79	37	45	15	30	0	0	4	0	16
3	27	12	30	35	37	85	145	175	68	2	4	10	0	0	0	6	0	3
4	0	0	0	4	9	13	35	40	13	0	0	0	0	0	0	0	0	0
5	80	86	48	143	117	115	110	120	102	0	0	10	0	0	22	0	0	4

TABLE 6. MINIMAL AND MOTIVATIONAL CONTEXTS

Minimal	Motivational
1. Look at this letter (Slide showing lower case m) Now point to your letter on your button just like mine. (S points to m)	1. Pick up the stamp that has this letter on it (slide of rubber stamp with m). Make that letter on your card. (S presses stamp on card making m imprint.)
2. Now look at this letter (Slide showing o) Point to this letter on your button. (S points to o)	2. Pick up the card that has this letter on it (slide showing o). Now take your pen and color that letter. (S colors letter o with felt pen)

TABLE 7. COMPARISON OF EACH STUDENT'S MEAN SCORE FOR SESSIONS 1-8 AND 9-16

Source	SS	df	MS	F
Between Treatments	6864	1	6864	11.69
Between Students	3475	4	869	1.48
Residual	2347	4	587	
Total	12686	9		

* $p < .05$

V. DISSEMINATION

A. INTRODUCTION

Currently the potential contribution of engineering technology is among the most discussed topics in education. At one extreme, this technology is seen in terms of typewriter stations hooked into computers; on the other, in terms of far simpler technology like tape recorders and transparency projectors. Probably the most important general development is the increasing availability of teaching equipment that makes use of the coordination of auditory and visual information both as instruction and feedback. In visiting other projects and schools making use of teaching machine technology, we have been most disappointed with the state of the art of programing machines, especially for young children.

Therefore, we consider our dissemination of information on the technology of programing automated equipment very important. In the process of conducting our research, we have developed a battery of techniques which involve the use of slides, the use of voice (often more than one), and the coordination of auditory and visual information. In our work we have had a special constraint in having to supply the total instruction by machine. In requiring the machine lessons to carry the entire burden of instruction, we have had to make certain that the lessons are effective and maintain the children's attention. Thus we have had to develop a host of motivational techniques to incorporate in the lessons to maintain the children's interest and involvement.

In a broader sense we can describe our work as contributing to the development of the technology and the art of programing both simple and complex teaching machines for learning. While we have primarily worked with an automated typewriter, we have also had experience with tape recorders coordinated with picture booklets.

A further dimension of our work has involved the use of paraprofessionals both to help in the research and in running the project. That is, we have been concerned with practical issues of the management of systems making use of such equipment. Our project has been to design materials in such a way that individual branching can be managed with limited professional supervision.

Two types of dissemination activities are discussed. The first involves uses of the specific lesson sequences. The second involves information concerning the technology of programing automated equipment.

B. USES OF THE LESSON SEQUENCES

Under the first type of dissemination are discussed 1) the adoption of the sequences for use by other projects, 2) the use of portions of the lessons as remedial sequences, and 3) the translation of the lessons into a more practical presentation format.

1. Adoption of Lesson Sequences

A major outcome of a project which accepts a programed instructional orientation is the sequence of lessons itself. These sequences represent a reproducible set of instructional events which can be used not only in our own setting but in

any setting that has this piece of equipment available.

One government project concerned with the instruction of five-year-olds in a ghetto school setting has adopted our lessons.

2. Use of the Lessons for Remedial Instruction

A test of the efficacy of the lesson sequences for a very different purpose was conducted. In P.S. 175, the school in which we work, the children in an experimental kindergarten class were receiving instruction in the same beginning reading skills. Some of the children, primarily those whose progress was limited, were pretested on the skills described in Section III and given appropriate chunks from the lesson sequences.

The results of the pre and posttest for the children is presented in Table 8. The pretest results for these children is clearly higher than the results for the kindergarten children who had had no previous instruction (Tables 1 and 2, Section III). However, nearly all of these children indicated they had difficulty with the higher order skills involving the unitary responses. Each child was placed on those segments of the lesson series which seemed relevant from pretest results.

In every instance, the children showed gains. The most impressive part of the data is for those students who went through SR II, (the second revision) on which unitary response performance on both the indicating and oral response averaged greater than 90%. Not only did all subjects gain but the results of remedial instruction using the later revision indicated superior results.

3. Translation of Lessons into Other Formats

Much instruction of the type used in this project is expensive.

TABLE 8. ENRICHMENT KINDERGARTEN

SR I (First Revision)

Student Number	PRETEST Single Sounds Indicate	PRETEST Single Sounds Oral	PRETEST Unitary Response Two and Three Letters Indicate	PRETEST Unitary Response Two and Three Letters Oral	POSTTEST Single Sounds Indicate	POSTTEST Single Sounds Oral	POSTTEST Unitary Response Two and Three Letters Indicate	POSTTEST Unitary Response Two and Three Letters Oral
	%	%	%	%	%	%	%	%
1	33.3	0.0	0.0	12.5	100.0	100.0	80.0	64.5
2	100.0	100.0	20.0	62.0	100.0	100.0	80.0	87.5
3	100.0	100.0	20.0	18.7	100.0	100.0	40.0	93.7
4	33.3	66.6	20.0	12.5	100.0	100.0	60.0	48.7
$\overline{X}$	66.6	66.6	15.0	26.4	100.0	100.0	60.0	73.6
			SR II (Second Revision)					
5	100.0	66.6	40.0	18.7	100.0	100.0	100.0	75.0
6	100.0	100.0	20.0	31.0	100.0	100.0	80.0	87.5
7	100.0	100.0	60.0	25.0	100.0	100.0	100.0	100.0
8	100.0	100.0	100.0	68.7	100.0	100.0	100.0	100.0
$\overline{X}$	100.0	91.4	55.0	33.3	100.0	100.0	95.0	90.6

In our project our primary concern involves researching the ways of optimizing the acquisition of beginning reading skills. Using this type of equipment is extremely valuable for research and experimental purposes.

In the process of using such equipment we developed a body of reproducible knowledge housed in the lesson sequences. The question we have now raised and will research further in the remainder of the project is, "Once that knowledge has been developed are there alternative, less expensive and more flexible means of presenting the lessons?"

In a pilot study we made use of a slide projector with a synchronized tape recorder to present lesson contents to a small group of children. The children responded by pointing to or holding up letters as well as speaking. The initial findings suggest that this technique deserves further exploration. Twenty-five lessons have already been translated into this format and will be tested during the remainder of our project.

C. THE TECHNOLOGY OF PROGRAMING AUTOMATED EQUIPMENT

Under the second type of dissemination we discuss 1) our demonstration-seminars, 2) consultation with other projects, and 3) simulation of lessons.

1. The Weekly Demonstration-Seminars

Public and professional interest in projects making use of complex teaching machine technology is considerable and growing. However, we have found that the information which most people have concerning the nature and use of the equipment is based upon

informal newspaper, magazine and word-of-mouth accounts. The impressions which people have obtained from these have often been less than accurate. While we recognise that we have some responsibility for providing more accurate information about such teaching machine equipment, we also recognize that there is a certain danger in opening the doors of an experimental laboratory to visitors. The major danger is that the researchers will spend more time talking about this work than creating programs and researching them.

Our solution to this situation was to institute a weekly demonstration-seminar. The seminars combined the opportunity to observe children working through lessons with discussions of the records and observations. The use of two-way mirrors in the machine room permitted visitors to observe children without the children being aware of it.

In order to waste as little time as possible in answering repetitious questions, we prepared a "dialogue" (See Appendix A of the Third Progress Report) which provided written answers to those questions which were most often asked. The dialogue was sent in advance to prospective visitors, enabling them to prepare for the seminar.

2. Consultation

Three projects making use of the type of equipment we have been using have come to us for assistance. Two of the projects have been concerned with using our programs as the basis of their use of the equipment. In one instance, we actually trained the

person who is running the project, and all of our lessons have been reproduced for their use. The third project making use of such equipment came to us for training. The training was less on matters of the technicalities of the particular equipment, than techniques and motivational strategies for writing lessons.

3. Simulation of Lessons

In March we presented for the second year a symposium on our work at the National Society for Programed Instruction. As part of that seminar we made use of a tape recorder with slide coordination to simulate lessons. What made this especially effective were the verbal responses of the individual children going through the lessons. This presentation resulted in requests for copies of the presentation from research and training centers at Harvard, Catholic U., and the Eastern Regional Laboratory (ERIE).

VI. SCHEDULE FOR REMAINDER OF THE PROJECT

The time schedule for the remainder of the project is as follows:

A. OCTOBER 1 - NOVEMBER 1, 1967

During this period the major activity involves the pre-testing of the subjects. The experimental group will be comprised of thirty children who will receive the machine lessons. These children will come from one morning and one afternoon class. The control group of thirty children will be taken from one morning and one afternoon class.

Two types of pretests will be administered. The first is the WPPSI (Wechsler Preschool and Primary Scale of Intelligence). The second type of test concerns the specific skills to be taught in the lesson sequences. Fortunately, we will have available first grade children who have been through the previous lessons. Such testing and added revisions may even continue beyond November 1.

B. NOVEMBER 1, 1967 - FEBRUARY 29, 1968

The experimental group will be provided with the lesson sequences. The minimum number of lessons is seventy and the minimum time to complete these is approximately 560 minutes, about 9⅓ instructional hours. (In our original proposal we estimated the vertical lesson sequence to consist of thirty lessons, averaging fifteen minutes each, a total of 450 minutes.) Most subjects will probably have somewhat more than seventy

lessons. Additional lessons from horizontal sequences, will be used with children who have been absent or are not able to master a particular skill with a single presentation.

Another objective to be accomplished during this period involves field tests of the translation of lesson sequences for group presentation in a less expensive mode (Section V).

C. MARCH 1 - APRIL 30, 1968 DATA ANALYSIS AND REPORT WRITING

Analyses of the results will seek to answer the following questions:

1. How effective are the lessons in achieving their reading skill objectives? These results will be presented as descriptive statistics documenting the proportions of students reaching various levels of achievement.

2. What types of individual differences are demonstrated? For example, do all of the children who reach a particular level of mastery have similar problems in regard their need for supplementary instruction from horizontal branches? Among these data also will be reported the number of refusals.

3. Does the entire IQ test and/or subtests predict to achievement in the lesson sequence or to other behavior in the lessons themselves? The importance of these measures rests in the commitment of programers to enable all members of their target populations to reach their terminal objectives.

4. Do the effects of mastering these skills and being exposed to such instruction generalize to IQ gains and to superior performance on a reading prognosis posttest?

5. How effective is the presentation of the lesson sequences translated into the slide-tape format in comparison with the individualized presentation utilizing the ERE instrument?

6. What is the cost of using the ERE instrument per instructional hour? This question will be answered by analyzing the costs involved in maintaining the room, servicing the machine and providing for the children during the period when the maximum number of children are going through the lessons in the experimental test.

Appendix A

Figure 1..... Minimal and Motivational Stimuli

Figure 2 ..... Charmer Story

Figure 3 ..... Lump Story

Figure 4 ..... Zoo Story

Figure 5 ..... Hide and Seek Story

Figure 6 ..... Box Game Story

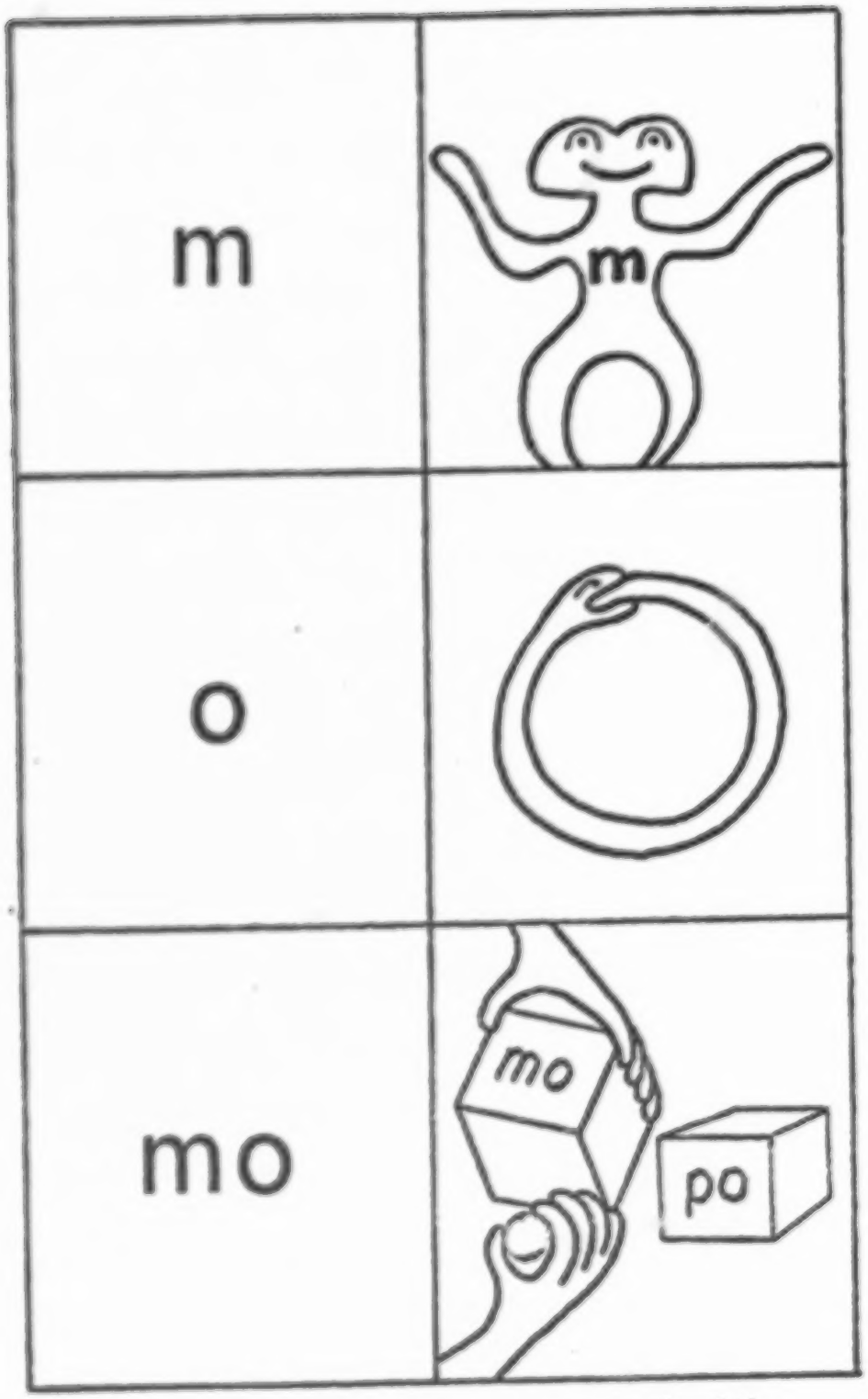
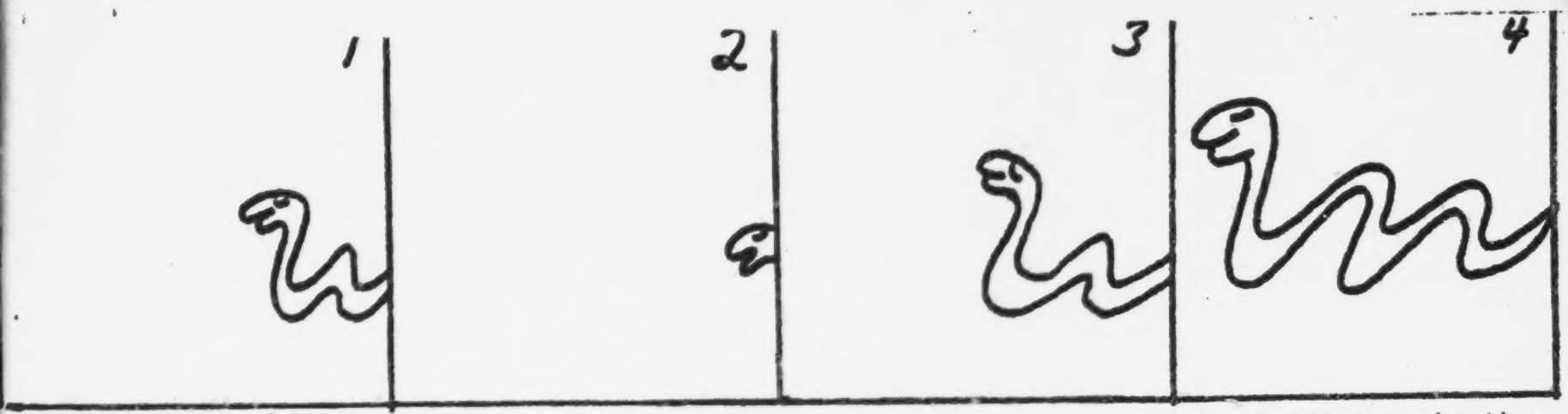


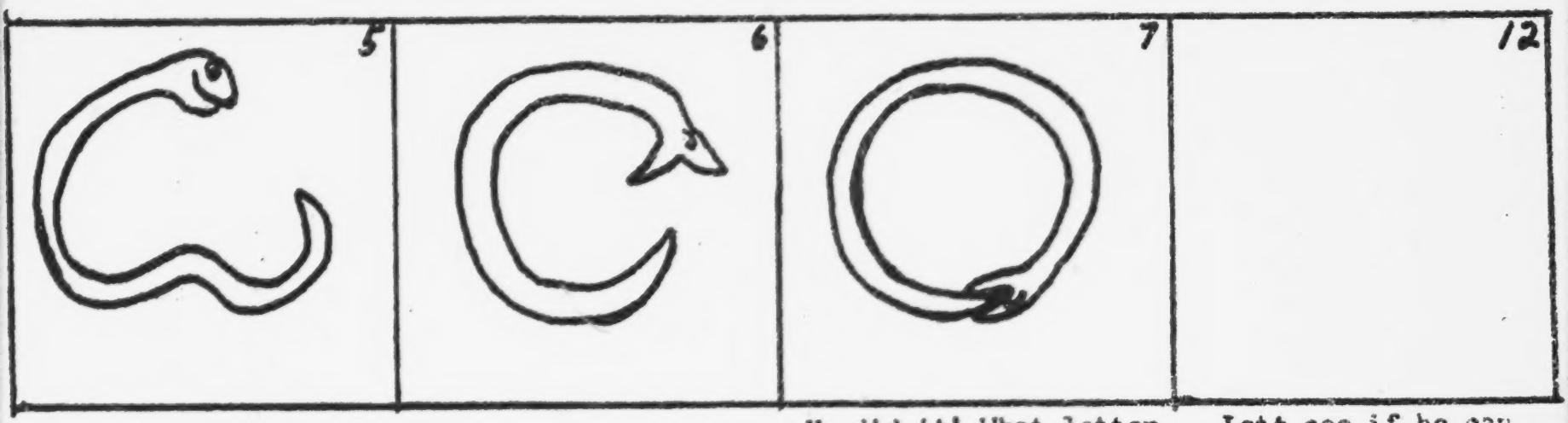
Fig. 1. Minimal context compared with motivational context.



This is Mr.Charmer. Say hello Mr. Charmer.....

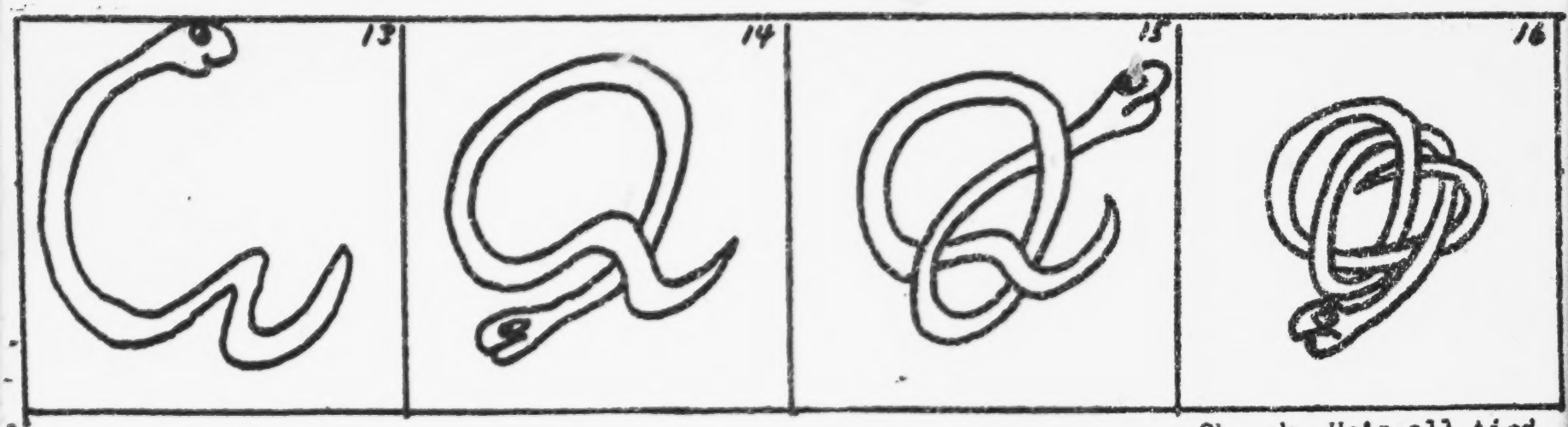
Oh look, he's bashful. Say, come on out Mr. Charmer.....

Tell him to make the letter/o/,say make o .....(press o)

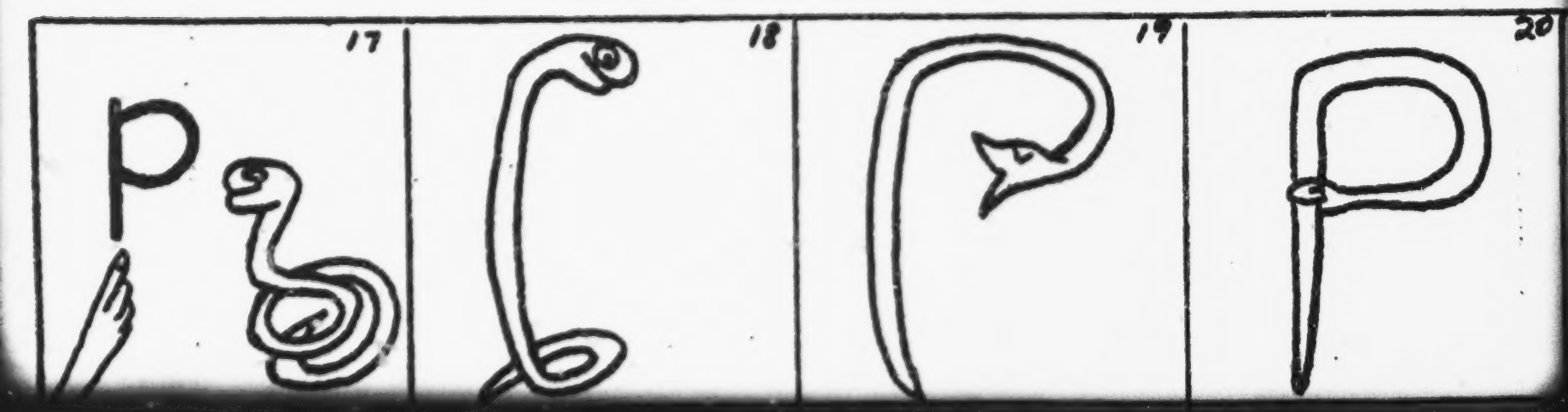


He did it! What letter did he make?.....It's o

Lets see if he can make /r/ all by himself..



Oh, oh. He's all tied up in knots. You show him the letter p, point to p.



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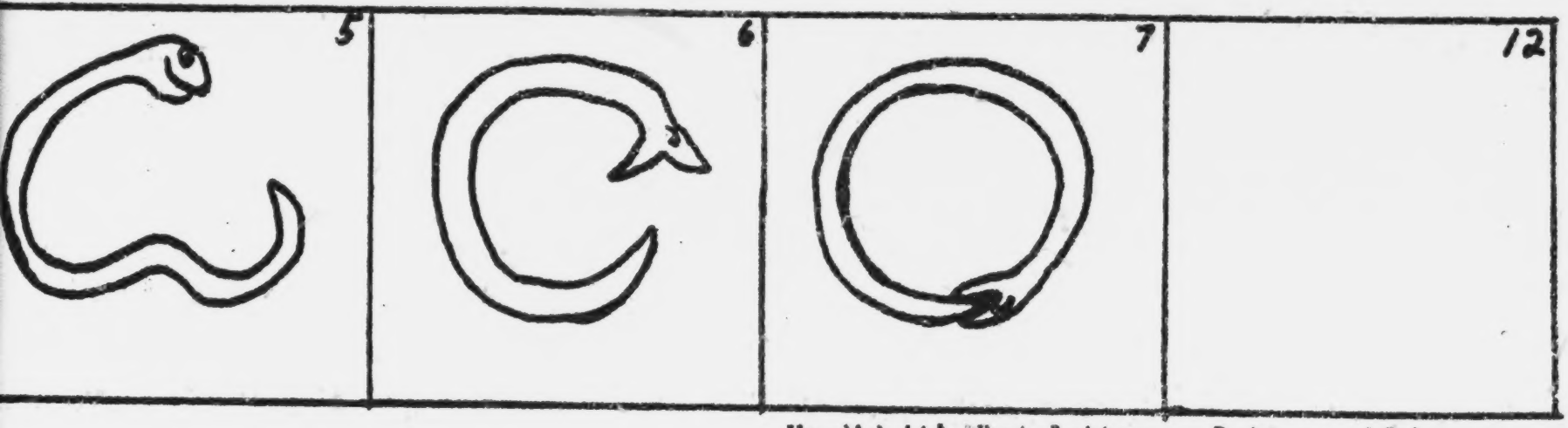
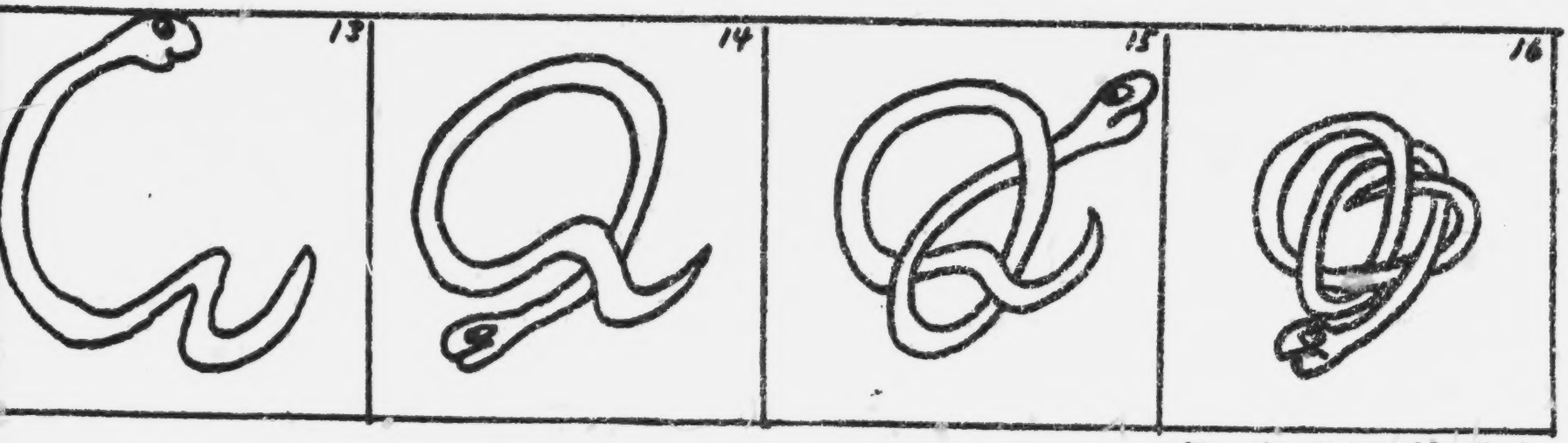
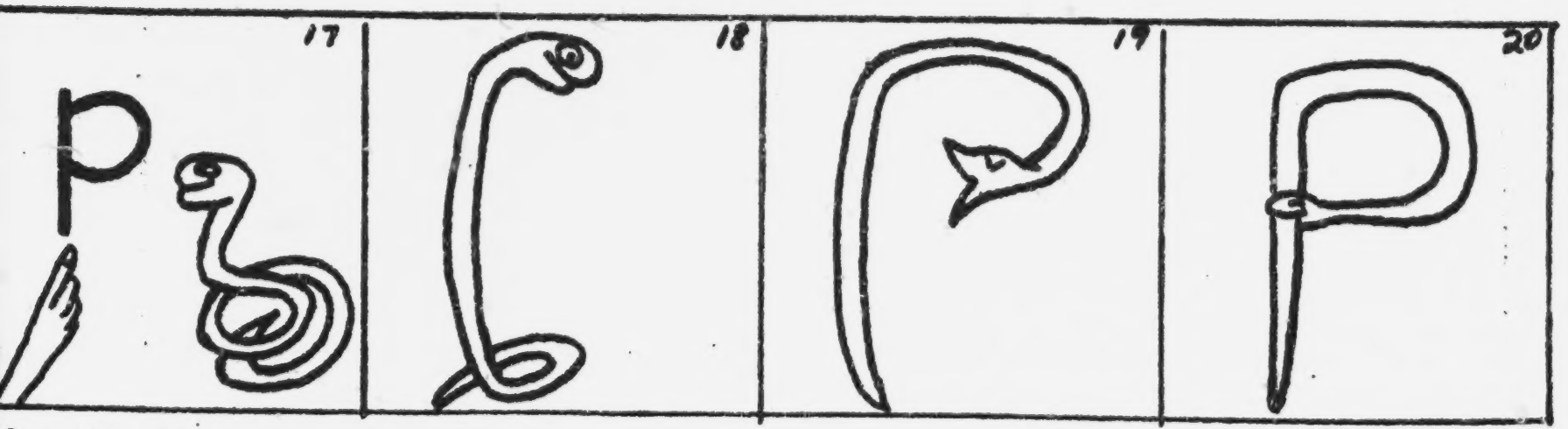


He did it! What letter did he make?.....it's o

Let's see if he can make /p/ all by himself..



Oh, oh. He's all tied up in knots. You show him the letter p, point to p.



Say this is p..... Say make p..... (press p)

He did it! What letter did he make? .....it's p.

Fig. 2. Mr. Charmer
Lesson 8.

1

Hello.I'll tell you a story about a lump,but first point to /p/,the pipe letter..(press p)

2

What sound does this letter make?..... .....it's /p/(press p)

3

Here's the lump. Say hello lump.....

4

The lump never did anything. He just laid around the park like a dumpy old bump.

5

Do you remember /m/? Point to m, the mask letter...(press m).

6

What sound does this letter make?..... .....it's m

8

Sometimes the lump laid around like a dirty old spot.

10

Dogs fought over him. He was just a dumpy old lump. Point to/o/, the round letter(presso.

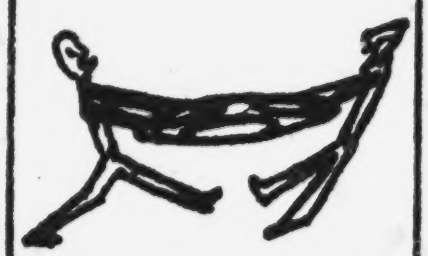
13

One day some kids made him into a swing. He liked that-he began to play with kids(press o)

14

What sound does this letter make?..... .....it's o..

19



-then there was a fight."gimme that lump" "No! He's mine!"- (press m)

20

The lump was torn to pieces-. (press m)

21

What sound does this letter make?..... it's m.

25

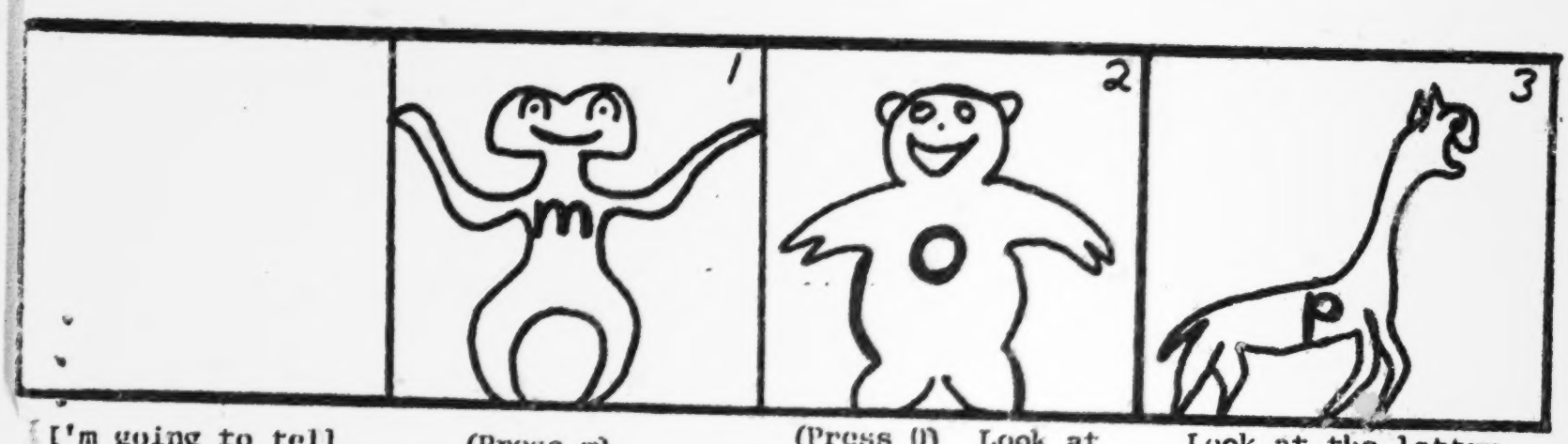
A girl found the pieces and sewed the lump together. Point to p, (press p).

26

What sound does this letter make?..... .....it's p.

28

But the lump was no goo anymore. When he moved he hurt all over. So he laid around and people walked all over the lazy lump.



I'm going to tell you about some funny animals at the zoo. Did you ever go to the zoo?

(Press m) Look at the letter on this animal. Is it /p/ or /m/?..It's /m/.-His name is /m/

(Press O) Look at the letter on- Is it /o/ or /m/?.../o/.- Now point to /p/ (Press p)

Look at the letter on--- Is it /o/ or /p/?.... /p/.

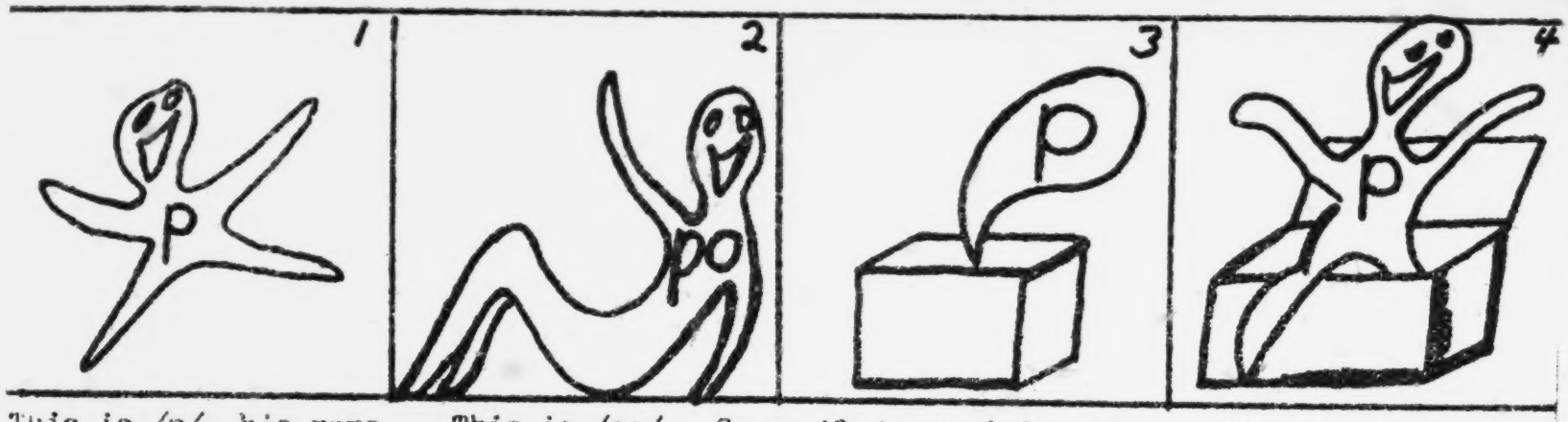
These funny animals don't stay in cages. They walk all over the zoo. (Press p).

Here comes one of the animals to get some peanuts. Which animal is that?... It's p.

This funny animal is on top of the peanut man? Which animal is that?... m.

Who's that in the tree? It's o.

Fig. 4. Zoo Story
Lesson 14

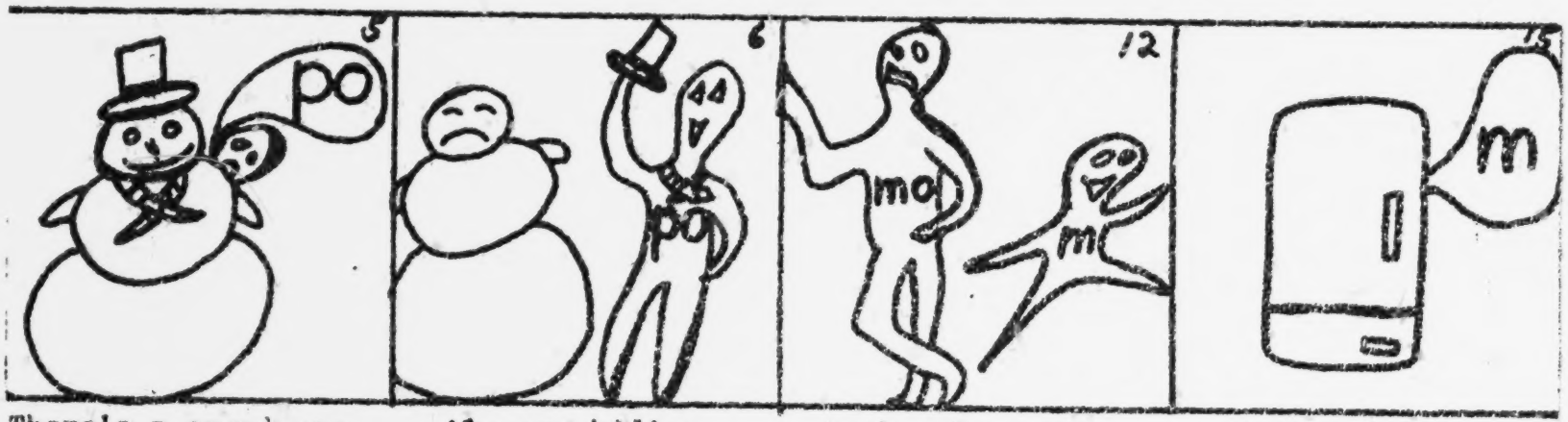


This is /p/, his name is on his shirt. Say hello /p/.... What's his name?.../p/

This is /po/. Say hello /po/...They are going to hide. We have to find out who's hiding.

What sound is coming from that box. Is it p or po.... It's p

Who was in that box?... p.

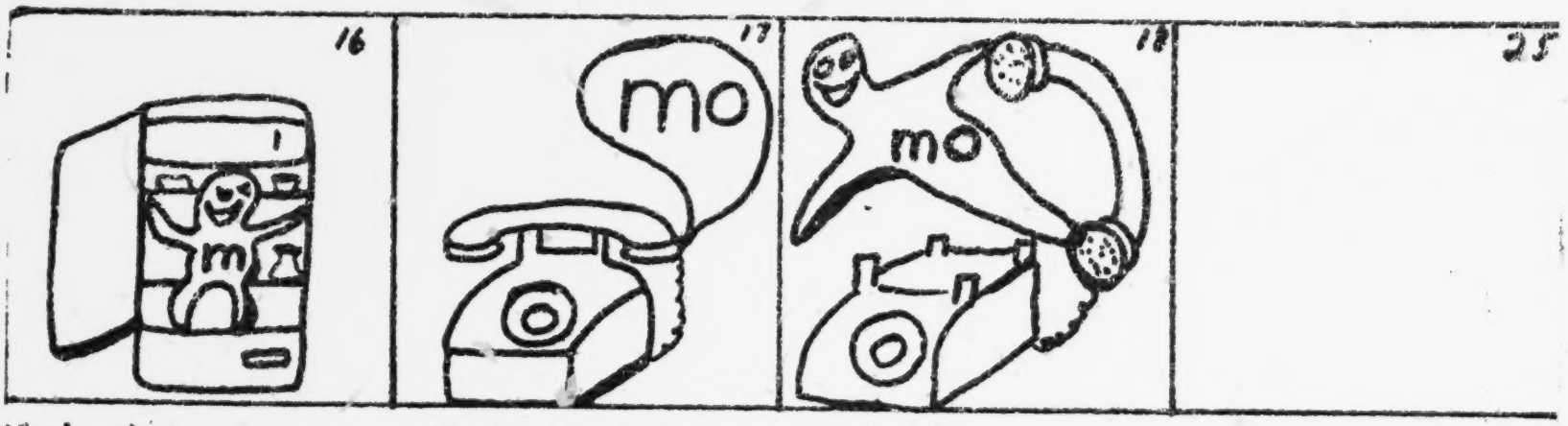


There's a sound coming from behind that snowman. Is it p or po?... po.

Who was hiding behind the snowman?...po

Let's play with two more guys. One is named /m/ and the other is /mo/

What sound---? m or mo?....It's m

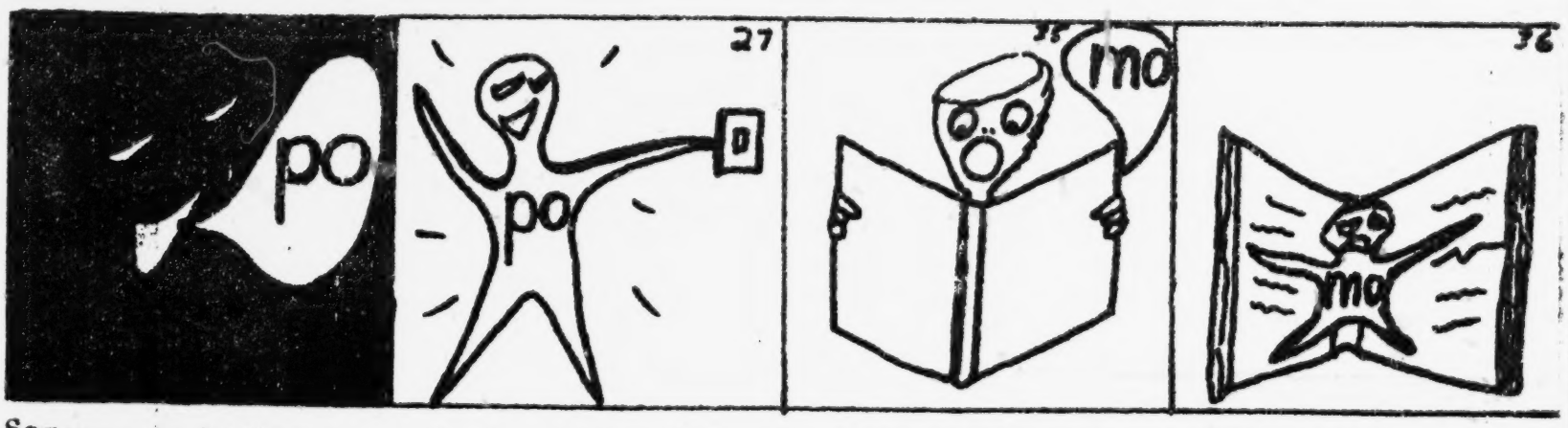


Who's that---? ... It's m

What sound---? m or mo.... It's mo

Who's that---?.... It's mo.

-----Now we have to find out if it's po or mo.

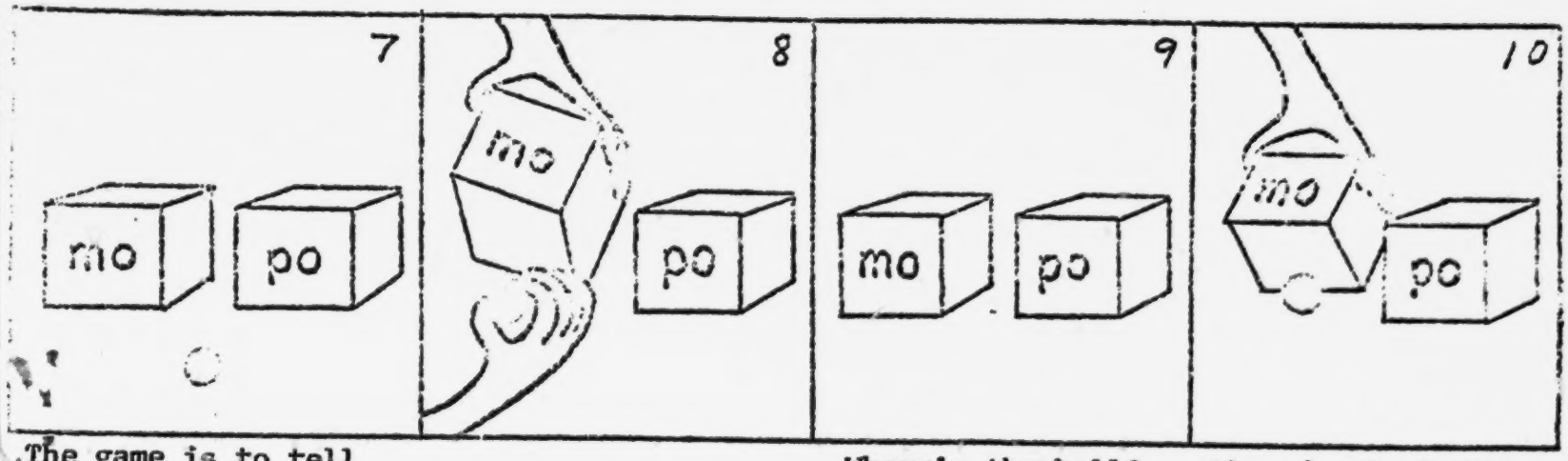


Someone is hiding in the dark--- Is it po or mo?... It's po.

He turned on the light... Who's that?... It's po.

What sound----? po or mo?...It's mo.

Who's that----?... It's mo.



The game is to tell which box the ball is under.

Where's the ball? Under the mo or the po box?..... Under the mo box.

Where's the ball? .....it's under the mo box.

Fig. 6. Box Game
Lesson 32